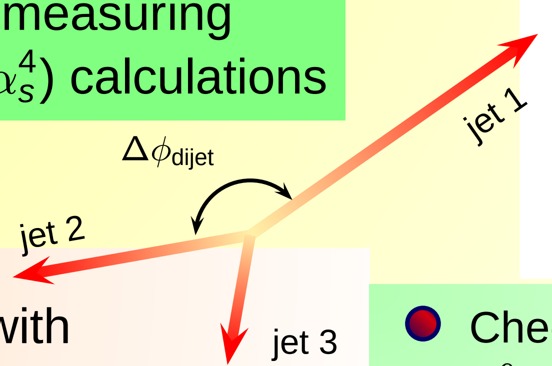
Azimuthal Decorrelations with Early ATLAS Data

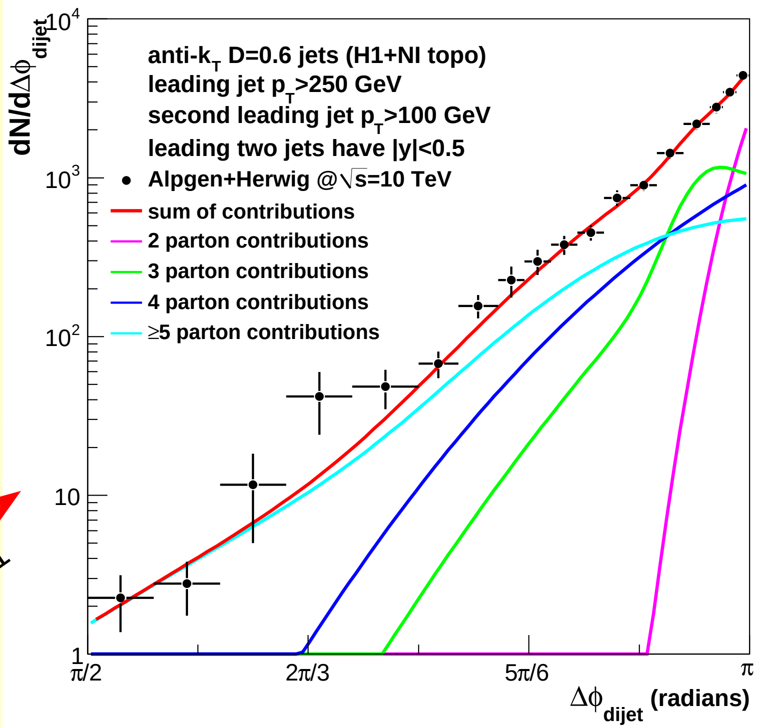
ϕ Decorrelation in Dijet Events

Azimuthal angle between leading two jets reflects activity in rest of event

- Soft radiation causes small azimuthal decorrelations
- Additional hard radiation can lead to large azimuthal decorrelations

$\Delta\phi_{\rm dijet}$ sensitive to higher-order QCD radiation without explicitly measuring additional jets $\Rightarrow$ tests $\mathcal{O}(\alpha_s^4)$ calculations





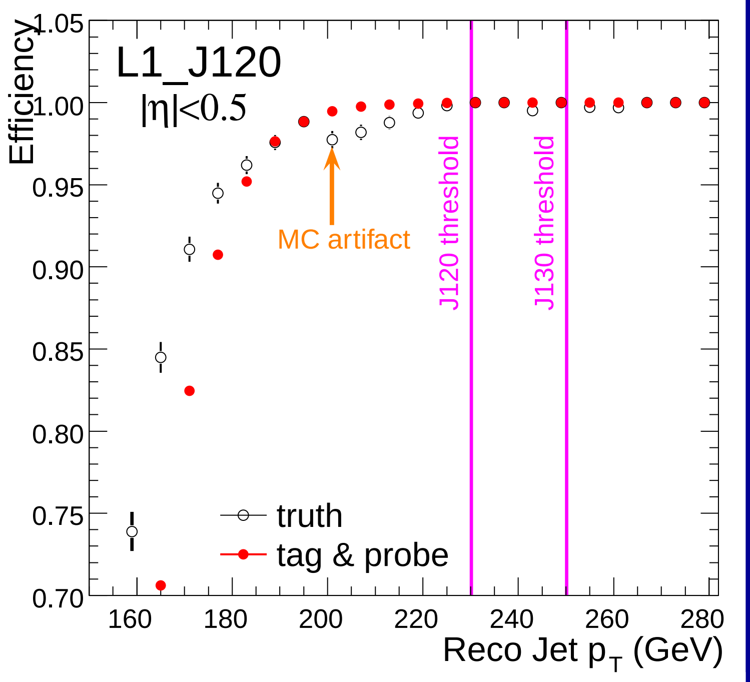
$\frac{1}{\sigma_{\rm dijet}} \cdot \frac{d\sigma_{\rm dijet}}{d\Delta\phi_{\rm dijet}}$ measured with

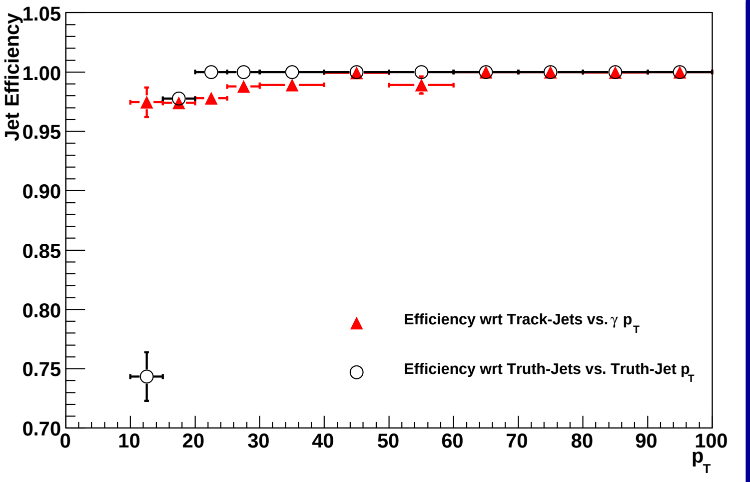
- both leading jets at central rapidities provides a precision test of NLO pQCD
- both leading jets at large rapidities also probes BFKL (rapidity gaps)
- other configurations useful for tuning Monte Carlo event generators

- Check NLO pQCD with limited statistics ($\int \mathcal{L} \sim 1\text{pb}^{-1}$) and large JES uncertainty
- Analysis presented today performed using PYTHIA J3–7 dijets. ALPGEN+HERWIG substitutes for data.
- Will expand measurement (e.g., multiple p_T bins, larger y coverage) with more integrated luminosity and calibrated JES.

Event Selection

- anti-k_T jets with D=0.6
  - apply MC-based JES using H1 with NI
  - no jet quality or overlap-removal criteria
- Require both leading jets to have $|y| < 0.5$
  - avoids crack region and lack of data-derived η-dependent JES corrections
  - can be expanded up to $|y| < 1$ if additional statistics are necessary
- Require leading jet $p_T > 250$ GeV based on inclusive jet trigger turn-on
  - must be on plateau
  - lowest threshold unprescaled trigger is L1_J130
  - L1_J120 exists in MC; scale up
- Require second leading jet $p_T > 100$ GeV based on jet-reconstruction efficiency
  - use track-based jets to determine turn-on
  - must be on plateau
  - 100 GeV requirement extremely conservative; can lower to $\sim$ 70 GeV to increase statistics

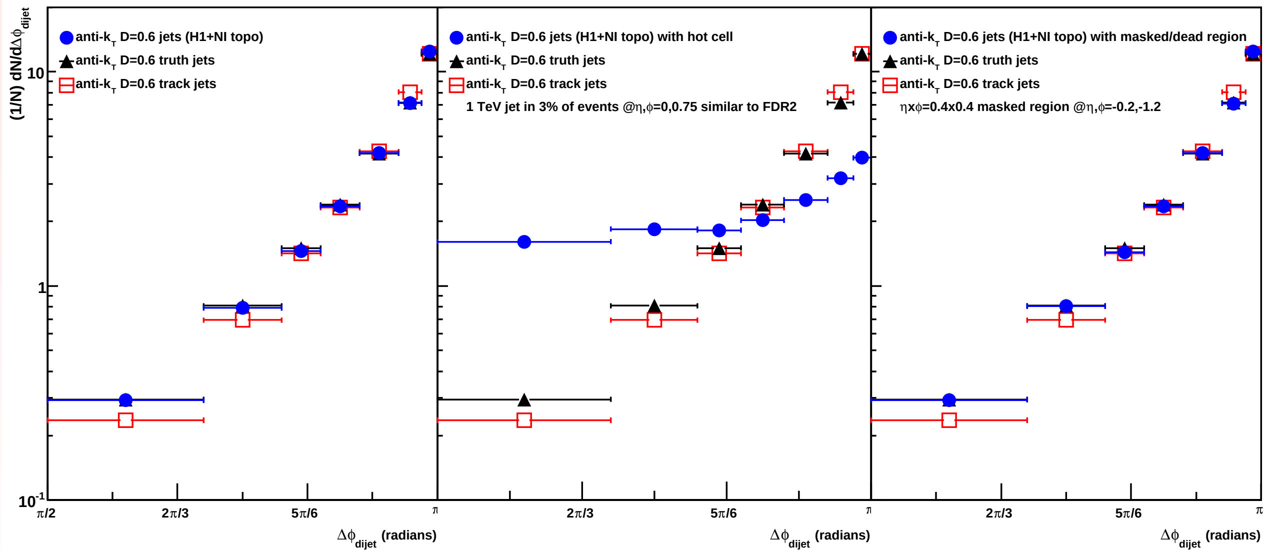




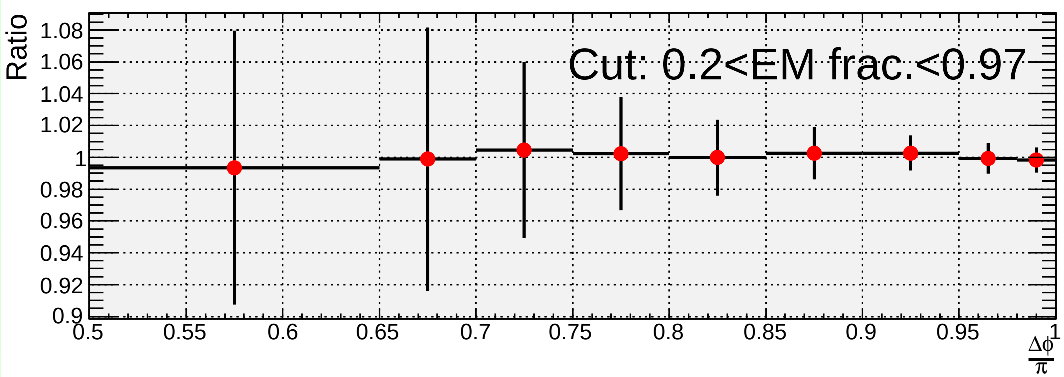
Analysis Issues

Data quality a key concern with events from the very early running period

- need tracker and calorimeter
- no attempt (yet) to use standard DQ tools
- use track-jets to identify calorimeter problems (hot cells, dead FEB)
- remove bad phase space
- correct for lost geometrical acceptance



Observable defined as $\frac{1}{\sigma_{\text{dijet}}} \cdot \frac{d\sigma_{\text{dijet}}}{d\Delta\phi_{\text{dijet}}}$

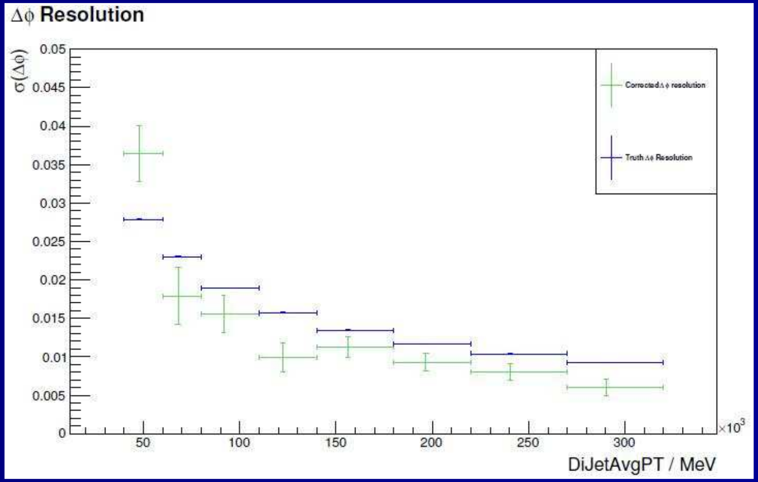


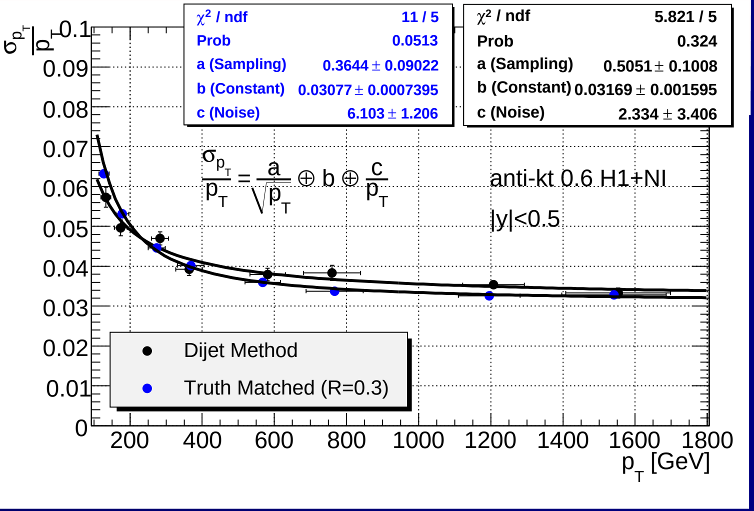
- efficiencies must be flat versus $\Delta\phi$
- absolute efficiency not important (no luminosity uncertainty)
- reduced dependence on JES
  - angles less sensitive to JES variations
  - requires ϕ intercalibration
  - absolute JES is dominant systematic uncertainty, however, effect limited to smearing across minimum p_T cuts

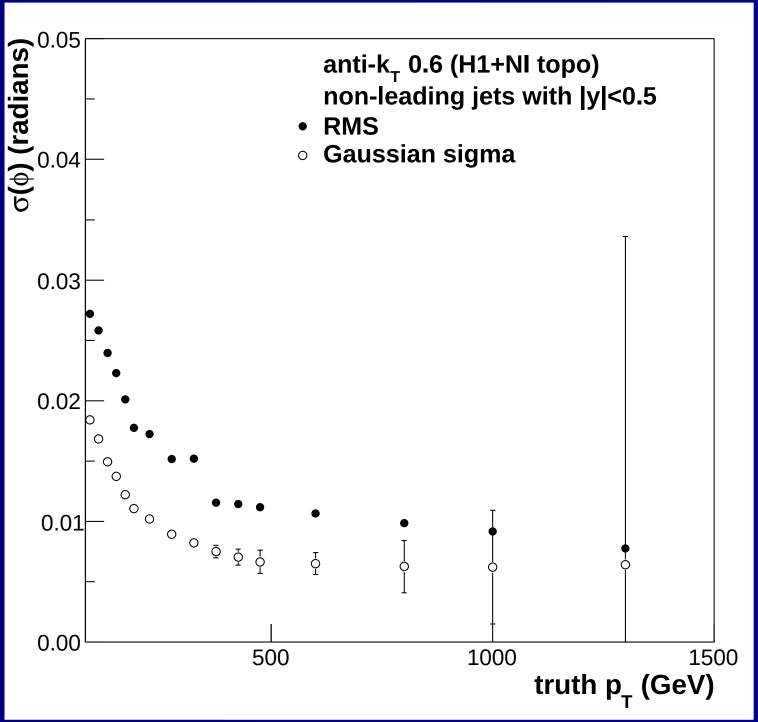
Unfolding

Result corrected for finite experimental resolution to compare with NLO pQCD prediction

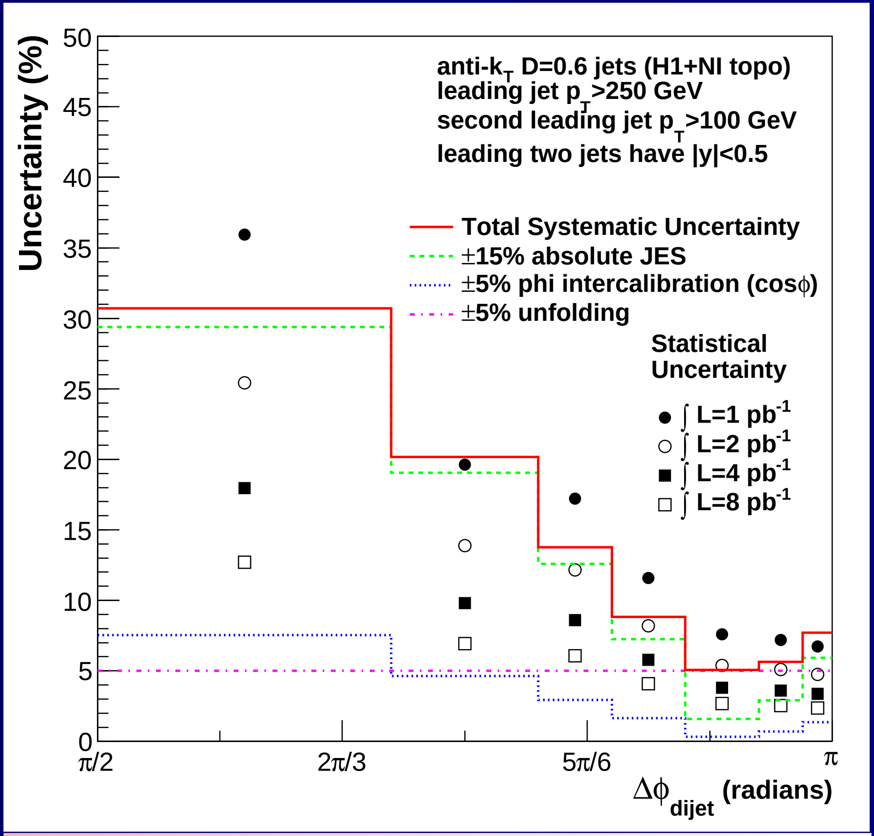
- measure jet resolutions:
  - p_T resolution extracted using dijet asymmetry
  - same method can measure $\Delta\phi$ resolution for $\Delta\phi \sim \pi \Rightarrow$ compare data and MC
  - take ϕ and y resolutions from MC
- studying two unfolding techniques:
  - highly parameterized MC (resolution functions)
  - regularized migration matrix (SVD in RooUnfold)
- current result uses truth-based unfolding
- bins chosen to have $\approx$ 90% purity





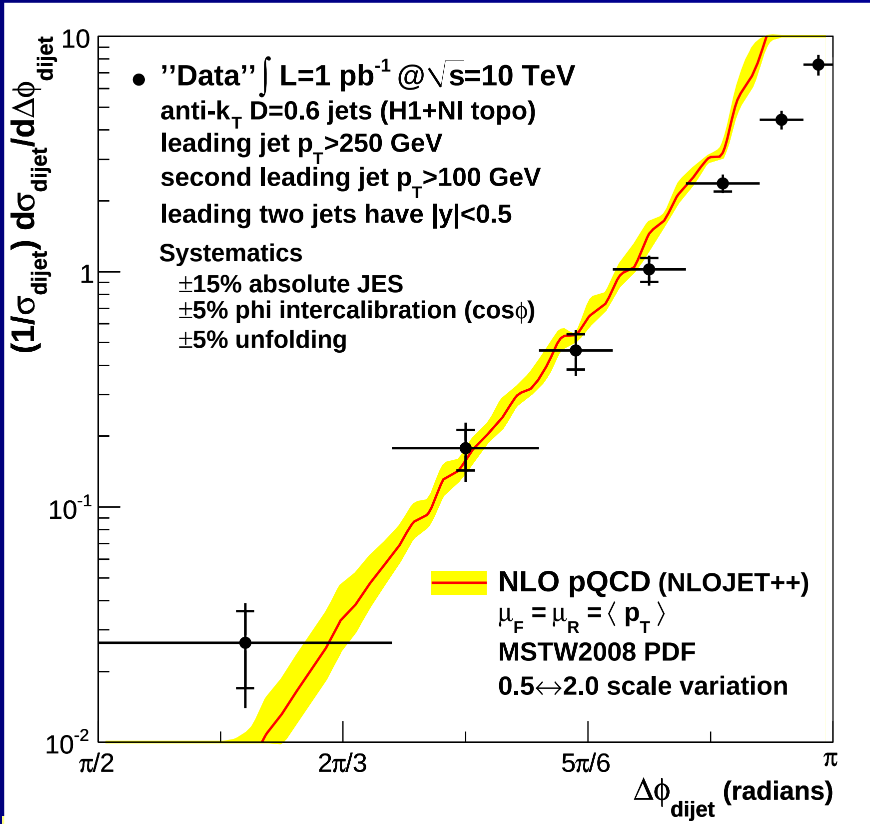


Measurement



Considered following sources of systematic uncertainty:

- $\pm$15% absolute JES ← dominant source of systematic uncertainty
- $\pm$5% ϕ-intercalibration (implemented as a cos ϕ distribution)
- $\pm$5% unfolding



ALPGEN + HERWIG "data" assuming $\int \mathcal{L} = 1\text{pb}^{-1}$ compared to NLO pQCD calculation (NLOJET++)

- $\mu_F = \mu_R = \langle p_T \rangle$
- scale uncertainty indicated by yellow band
- MSTW2008 NLO PDF (68% CL)